Ventana VT1 Interface Profile

Revision A

Version 0.7.0

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Table of Contents

Introduction

This specification describes Revision A (or Rev A) of the Ventana VT1 interface profile for the ODSA Transaction and Link Layer Specification for BoW Interfaces. Per that specification, the following are defined in this document:

- The inclusion or exclusion of optional fields on the interface protocol channels
- The width of each field on the interface protocol channels
- The bundling and mapping of fields into the payloads of various TLP types
- The use of the auxiliary field in the TLP header for each TLP type
- The definition of any additional TLP types for control information
- The assignment of TLP types into TLP streams
- The bundling of TLP streams into a TLP class
- The support for credit (CRD) and message (MSG) TLPs
- The number and assignment of virtual wires and the reset state of each virtual wire

Additional information about the interface profile is provided in the following sections.

Overview

The VT1 interface profile supports CHI and AXI5-Lite interface protocols, classified into TLP classes, streams, and types as shown below:

TLP Class	TLP Stream	TLP Type	TlpHdr Type
AXI5-Lite	A5LAWW	AWW64	0x08
	A5LB	B	0x09
	A5LAR	AR	0x0A
	A5LR	R64	0x0B
	None	A5LCRD	0x0C
CHI	CHIREQ	REQSTD	0x20
		REQCMP	0x21
	CHISNP	SNPSTD	0x22
		SNPCMP	0x23
	CHIRSP	RSP	0x24
	CHIDAT	DAT256	0x25

	None	CHICRD	0x26

VT1 Interface Profile TLP Classes, Streams, and Types

The VT1 interface profile does *not* support CRD TLPs but does support MSG TLPs. In addition, the profile defines a number of virtual wires.

Implementations are characterized as either a *spoke controller* or a *hub controller*. The subsets of the profile supported by each are described in the remaining sections.

CHI Class

The CHI TLP class of the VT1 interface profile supports CHI Issue D. When encapsulated into a TLP, CHI protocol packets largely retain their specified format, as defined for each of the four virtual channels (i.e. REQ, SNP, RSP, and DAT) in the CHI specification. The following parameters apply:

- NodeIDs are 11b (the maximum allowed)
- Addresses are 52b (the maximum allowed)
- MPAM is *not* supported
- RSVDC is *not* supported
- Data are 256b
- DataCheck is *not* supported
- Poison is supported

To minimize transmission overhead, REQ and SNP protocol packets are classified into standard and compressed TLPs based on opcode. A standard TLP reflects the CHI protocol packet definition, while a compressed TLP omits some fields whose values can be removed by the TX interface and inferred by the RX interface. This lossless compression scheme is contained completely within the VT1 interface profile.

The VT1 interface profile classifies CHI TLPs into one of four TLP streams: CHIREQ, CHISNP, CHIRSP, and CHIDAT.

For CHI TLPs, the Aux field in the TLP header grants credits for the various TLP streams:

4	3	2	1	0
CHIDAT[1:0]		CHIRSP[0]	CHISNP[0]	CHIREQ[0]

A one in bits 0 through 2 indicates that a single credit has been granted for the corresponding stream, while a zero indicates that no credits have been granted. Bits 3 and 4 allow from zero to three credits to be granted for the CHIDAT stream.

A CHICRD TLP is also defined to transmit additional credits for each of the TLP streams.

The CHI class effectively connects an RN implemented on a spoke with an ICN implemented on a hub. A spoke controller transmits the following TLP streams:

- CHIREQ
- CHIRSP
- CHIDAT

A hub controller transmits the following TLP streams:

- CHISNP
- CHIRSP
- CHIDAT

The streams transmitted by one type of controller are received by the other type. Both types transmit and receive CHICRD TLPs (described below).

CHIREQ Stream

The CHIREQ stream consists of REQSTD and REQCMP packets, described below.

REQSTD TLP

REQSTD (i.e. standard REQ) TLPs are transmitted for the following opcodes:

- Opcodes
  - ReadNoSnp
  - ReadNoSnpSep
  - CleanSharedPersist
  - CleanSharedPersistSep
  - WriteUniquePtlStash
  - WriteUniqueFullStash
  - StashOnceUnique
  - StashOnceShared
  - AtomicLoad
  - AtomicStore
  - AtomicCompare
  - AtomicSwap

The format for the REQSTD TLP is illustrated below:

REQSTD		
Field	**Width**	**Bits**
TraceTag	1	[140]
ExpCompAck	1	[139]
Excl SnoopMe	1	[138]

LPID PGroupID	5	[137:133]
SnpAttr	1	[132]
MemAttr	4	[131:128]
PCrdType	4	[127:124]
Order	2	[123:122]
AllowRetry	1	[121]
LikelyShared	1	[120]
NS	1	[119]
Addr	52	[118:67]
Size	3	[66:64]
Opcode	6	[63:58]
TxnID	10	[57:48]
SrcID	11	[47:37]
TgtID	11	[36:26]
QoS	4	[25:22]
ReturnTxnID {0b0000, StashLPIDValid, StashLPID[4:0]}	10	[21:12]
StashNIDValid Endian Deep	1	[11]
ReturnNID StashNID	11	[10:0]

The fields that are removed from a REQSTD TLP to form a REQCMP TLP (below) are located in the least significant bits of the REQSTD TLP (as shown in light orange above). As a result, the field order in a REQSTD TLP is different from the standard CHI REQ packet.

REQCMP TLP

REQCMP (i.e. compressed REQ) TLPs are transmitted for the following opcodes:

- Opcodes
  - PrefetchTgt
  - PCrdReturn
  - DVMOp
  - ReadShared
  - ReadClean

    - ReadOnce
    - ReadUnique
    - ReadNotSharedDirty
    - CleanShared
    - CleanInvalid
    - MakeInvalid
    - ReadOnceCleanInvalid
    - ReadOnceMakeInvalid
    - CleanUnique
    - MakeUnique
    - Evict
    - WriteNoSnpPtl
    - WriteNoSnpFull
    - WriteEvictFull
    - WriteCleanFull
    - WriteBackPtl
    - WriteBackFull
    - WriteUniquePtl
    - WriteUniqueFull

REQCMP packets omit the following message fields:

- Omitted fields (must be zero)
    - ReturnNID/StashNID (11b)
    - StashNIDValid/Endian/Deep (1b)
    - ReturnTxnID/{StashLPIDValid,StashLPID} (10b)

The format for the REQCMP TLP is illustrated below:

REQCMP		
Field	**Width**	**Bits**
TraceTag	1	[118]
ExpCompAck	1	[117]
Excl SnoopMe	1	[116]
LPID PGroupID	5	[115:111]
SnpAttr	1	[110]
MemAttr	4	[109:106]
PCrdType	4	[105:102]
Order	2	[101:100]
AllowRetry	1	[99]

LikelyShared	1	[98]
NS	1	[97]
Addr	52	[96:45]
Size	3	[44:42]
Opcode	6	[41:36]
TxnID	10	[35:26]
SrcID	11	[25:15]
TgtID	11	[14:4]
QoS	4	[3:0]

Note: The delta between REQSTD and REQCMP is 22b, and the former packet requires 6 granules while the latter requires 5.

CHISNP Stream

The CHISNP stream consists of SNPSTD and SNPCMP packets, described below.

SNPSTD TLP

SNPSTD (i.e. standard SNP) TLPs are transmitted for the following opcodes:

- Opcodes
  - SnpSharedFwd
  - SnpCleanFwd
  - SnpOnceFwd
  - SnpNotSharedDirtyFwd
  - SnpUniqueFwd
  - SnpUniqueStash
  - SnpMakeInvalidStash
  - SnpStashUnique
  - SnpStashShared
  - SnpDVMOp

The format for the SNPSTD TLP is illustrated below:

SNPSTD		
Field	**Width**	**Bits**
TraceTag	1	[103]
RetToSrc	1	[102]
DoNotGoToSD DoNotDataPull	1	[101]

NS	1	[100]
Addr	49	[99:51]
Opcode	5	[50:46]
TxnID	10	[45:36]
SrcID	11	[35:25]
QoS	4	[24:21]
FwdNID	11	[20:10]
FwdTxnID[9:0] {0b0000, StashLPIDValid, StashLPID[4:0]} {0b00, VMIDExt[7:0]}	10	[9:0]

The fields that are removed from a SNPSTD TLP to form a SNPCMP TLP (below) are located in the least significant bits of the SNPSTD TLP (as shown in light orange above). As a result, the field order in a SNPSTD TLP is different from the standard CHI SNP packet.

SNPCMP TLP

SNPCMP (i.e. compressed SNP) TLPs are transmitted for the following opcodes:

- Opcodes
  - SnpShared
  - SnpClean
  - SnpOnce
  - SnpNotSharedDirty
  - SnpUnique
  - SnpCleanShared
  - SnpCleanInvalid
  - SnpMakeInvalid

SNPCMP TLPs omit the following message fields:

- Omitted fields (must be zero)
  - FwdNID (11b)
  - FwdTxnID/{StashLPIDValid,StashLPID}/VMIDExt (10b)

The format for the SNPCMP TLP is illustrated below:

SNPCMP		
Field	**Width**	**Bits**
TraceTag	1	[82]
RetToSrc	1	[81]

DoNotGoToSD DoNotDataPull	1	[80]
NS	1	[79]
Addr	49	[78:30]
Opcode	5	[29:25]
TxnID	10	[24:15]
SrcID	11	[14:4]
QoS	4	[3:0]

Note: The delta between SNPSTD and SNPCMP is 21b, and the former packet requires 5 granules while the latter requires 4.

CHIRSP Stream

The CHIRSP TLP stream consists of RSP packets, described below.

RSP TLP

RSP TLPs are the same as RSP protocol packets in the CHI specification. The format for the RSP TLP is illustrated below:

RSP		
Field	**Width**	**Bits**
TraceTag	1	[65]
PCrdType	4	[64:61]
DBID[9:0] {0b00000, PGroupID}	10	[60:51]
CBusy	3	[50:48]
FwdState DataPull	3	[47:45]
Resp	3	[44:42]
RespErr	2	[41:40]
Opcode	4	[39:36]
TxnID	10	[35:26]
SrcID	11	[25:15]
TgtID	11	[14:4]
QoS	4	[3:0]

CHIDAT Stream

The CHIDAT TLP stream consists of DAT256 packets, described below.

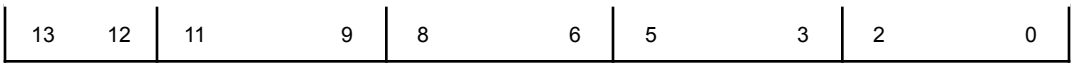
DAT256 TLP

DAT256 TLPs support 256b DAT packets in CHI. The format for the DAT256 TLP is illustrated below:

DAT256		
Field	**Width**	**Bits**
Poison	4	[369:366]
Data	256	[365:110]
BE	32	[109:78]
TraceTag	1	[77]
DataID	2	[76:75]
CCID	2	[74:73]
DBID	10	[72:63]
CBusy	3	[62:60]
{0b0, FwdState} {0b0, DataPull} DataSource[3:0]	4	[59:56]
Resp	3	[55:53]
RespErr	2	[52:51]
Opcode	4	[50:47]
HomeNID	11	[46:36]
TxnID	10	[35:26]
SrcID	11	[25:15]
TgtID	11	[14:4]
QoS	4	[3:0]

Miscellaneous TLPs

The CHI TLP class defines a CHICRD TLP that combines with the Aux field in the TLP header to grant large numbers of credits for each stream. The TLP payload for a CHICRD TLP is defined as follows:



Reserved	CHIDAT[4:2]	CHIRSP[3:1]	CHISNP[3:1]	CHIREQ[3:1]

The TLP payload and Aux field transfer up to 15 or 31 credits via a 4b value or 5b value, respectively, formed by concatenating a field in the TLP payload with the corresponding bits in the Aux field. For example, CHIDAT[4:0] represents 0 to 31 CHIDAT credits, where bits [4:2] are expressed in the TLP payload and bits [1:0] are expressed in the Aux field.

AXI5-Lite Class

AXI5-Lite transfers are encapsulated into TLPs based on the signals on the interface with the SoC on-die interconnect, as defined by AXI Issue G. The following constraints apply:

- AxID is 8b
- AxADDR is 52b

The VT1 interface profile classifies AXI5-Lite TLPs into one of four TLP streams: A5LAWW, A5LB, A5LAR, and A5LR.

For AXI5-Lite TLPs, the Aux field in the TLP header grants credits for the various TLP streams:

4	3	2	1	0
Reserved	A5LR[0]	A5LAR[0]	A5LB[0]	A5LAWW[0]

A one in bits 0 through 3 indicates that a credit has been granted for the corresponding stream, while a zero indicates that no credits have been granted. Bit 4 is *reserved* and *must* be zero.

An A5LCRD TLP is also defined to transmit additional credits for each of the TLP streams.

The AXI5-Lite class effectively connects an requester implemented on a hub with a responder implemented on a spoke. A hub controller transmits the following TLP streams:

- A5LAWW
- A5LAR

A spoke controller transmits the following TLP streams:

- A5LB
- A5LR

The streams transmitted by one type of controller are received by the other type. Both types transmit and receive A5LCRD TLPs (described below).

A5LAWW Stream

The A5LAWW stream consists of AWW64 packets, described below.

AWW64 TLP

AWW64 TLPs support 64b AXI5-Lite write data. The format for the AWW64 TLP is illustrated below:

AWW64		
Field	**Width**	**Bits**
AWID	8	[137:130]
AWADDR	52	[129:78]
AWPROT	3	[77:75]
AWSIZE	3	[74:72]
WDATA	64	[71:8]
WSTRB	8	[7:0]

Note: Fields highlighted in orange are reordered relative to the order of the signal lists in the AXI specification.

A5LB Stream

The A5LB stream consists of B packets, described below.

B TLP

The format for the B TLP is illustrated below:

B		
Field	**Width**	**Bits**
BID	8	[9:2]
BRESP	2	[1:0]

A5LAR Stream

The A5LAR stream consists of AR packets, described below.

AR TLP

The format for the AR TLP is illustrated below:

AR		
Field	**Width**	**Bits**

ARID	8	[65:58]
ARADDR	52	[57:6]
ARPROT	3	[5:3]
ARSIZE	3	[2:0]

Note: Fields highlighted in orange are reordered relative to the order of the signal lists in the AXI specification.

A5LR Stream

The A5LR stream consists of R64 packets, described below.

R64 TLP

The format for the R64 TLP is illustrated below:

R64		
Field	**Width**	**Bits**
RID	8	[73:66]
RDATA	64	[65:2]
RRESP	2	[1:0]

Miscellaneous TLPs

The AXI5-Lite TLP class defines an A5LCRD TLP that combines with the Aux field in the TLP header to grant large numbers of credits for each stream. The TLP payload for a A5LCRD TLP is defined as follows:

13 12	11 9	8 6	5 3	2 0
Reserved	A5LR[3:1]	A5LAR[3:1]	A5LB[3:1]	A5LAWW[3:1]

The TLP payload and the Aux field transfer up to 15 credits via a 4b value formed by concatenating a field in the TLP payload with the corresponding bits in the Aux field. For example, A5LR[3:0] represents 0 to 15 A5LR credits, where bits [3:1] are expressed in the TLP payload and bit [0] is expressed in the Aux field.

Virtual Wires

The VT1 interface profile supports virtual wires between a spoke controller and a hub controller. A spoke controller implements the following inputs and transmits the following VWX packets:

Spoke-to-Hub		
Spoke Input Hub Output	**VwId**	**Reset State**
SysCoReq	9	0b0
NMI	8	0b0
Fatal Error	7	0b0
Non-Critical Error	6	0b0
High Temperature	5	0b0
DM Interrupt	4	0b0
Trigger Out Req [1]	3	0b0
Trigger Out Req [0]	2	0b0
Trigger In Ack [1]	1	0b0
Trigger In Ack [0]	0	0b0

A hub controller implements the following inputs and transmits the following VWX packets:

Hub-to-Spoke		
Hub Input Spoke Output	**VwId**	**Reset State**
SysCoAck	12	0b0
External Interrupt [7]	11	0b0
External Interrupt [6]	10	0b0
External Interrupt [5]	9	0b0
External Interrupt [4]	8	0b0
External Interrupt [3]	7	0b0
External Interrupt [2]	6	0b0
External Interrupt [1]	5	0b0
External Interrupt [0]	5	0b0
System NMI	4	0b0
Trigger In Req [1]	3	0b0
Trigger In Req [0]	2	0b0

Trigger Out Ack [1]	1	0b0
Trigger Out Ack [0]	0	0b0

This specification recommends the following controller implementation behaviors:

- Any D2D errors detected by the spoke controller should be logically ORed with the NMI, Fatal Error, or Non-Critical Error input signals (as required by the system) to transmit the appropriate VWX packet
- Any D2D errors detected by the hub controller should be logically ORed with the received NMI, Fatal Error, or Non-Critical Error VWX packets (as required by the system) to assert the appropriate output signals